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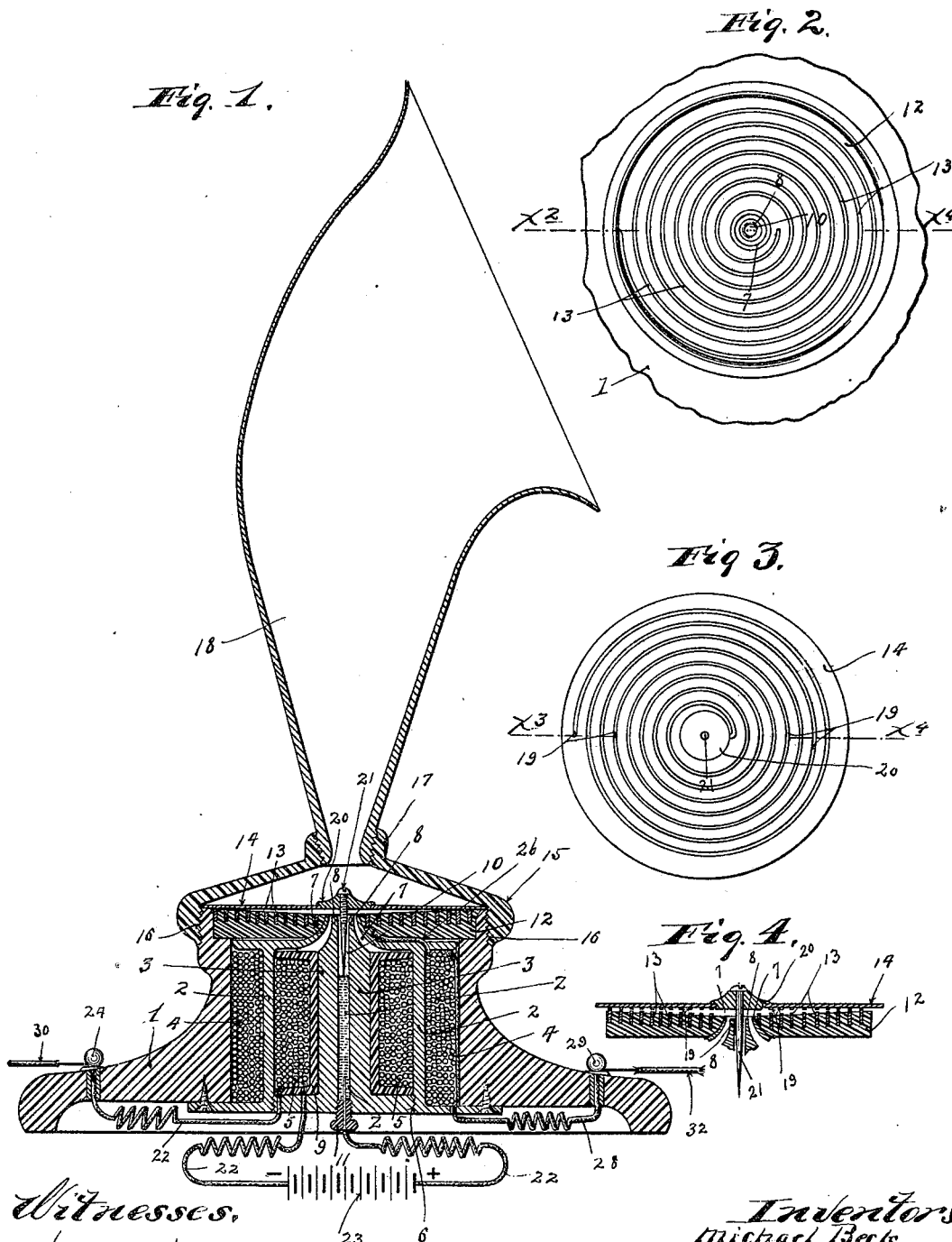
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TELEPHONE.

(Application filed July 18, 1899.)

(No Model.)

2 Sheets—Sheet 1



Witnesses,

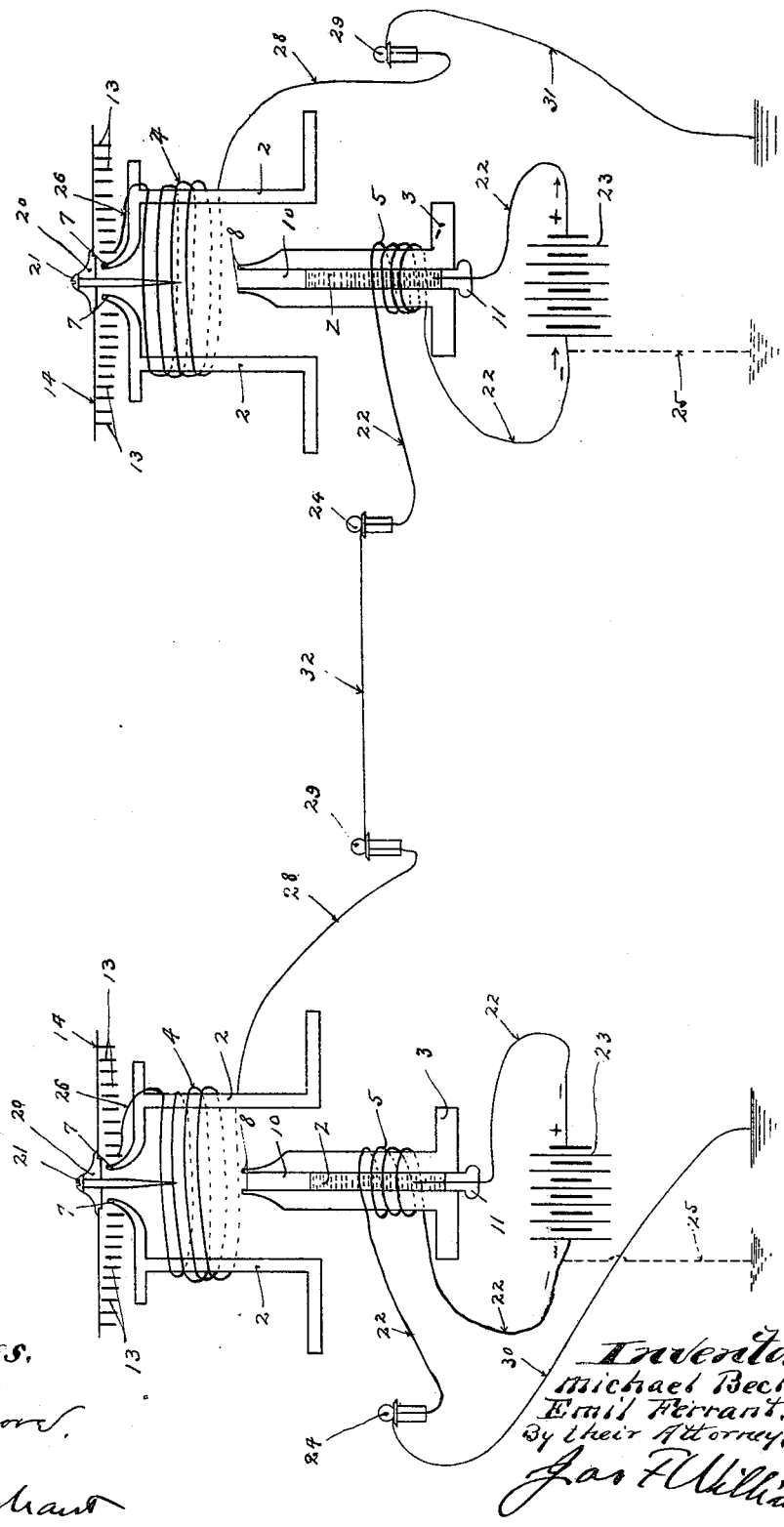
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Fig. 5.



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UNITED STATES PATENT OFFICE.

MICHAEL BECK AND EMIL FERRANT, OF MINNEAPOLIS, MINNESOTA.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 645,933, dated March 27, 1900.

Application filed July 18, 1899. Serial No. 724,215. (No model.)

To all whom it may concern:

Be it known that we, MICHAEL BECK and EMIL FERRANT, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Telephones; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to telephones, and has for its object to improve the same in the several particulars hereinafter noted; and to such ends it consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Figure 1 is a section taken centrally through one of our improved telephones. Fig. 2 is a plan view of the body portion of the telephone, some parts being removed and others broken away. Fig. 3 is a bottom plan view of the diaphragm. Fig. 4 is a transverse section taken through the diaphragm and immediately-associated parts on the line x^3x^4 of Fig. 3 and on the line x^2x^4 of Fig. 2, and Fig. 5 is a view in diagram illustrating several of the telephones connected in circuit or as part of the same system.

The instrument illustrated in Figs. 1 to 4, inclusive, is, in fact, a complete telephone, inasmuch as it is adapted to serve in turn either as a receiver or transmitter. Furthermore, when the instrument is connected in series with several of its kind it is adapted to act as a repeater to send forward through the circuit reinvigorated impulses.

In the illustration given the numeral 1 indicates a base-piece or socket which is recessed at its center to receive a pair of cylindrical and concentrically-disposed magnet-cores 2 and 3, around which coils 4 and 5, respectively, are wound. At their base ends the core-pieces 2 and 3 are secured together, as shown at 6, so that they have metallic contact; but at their upper ends they are contracted and brought close together, but not into contact, to form, respectively, pole-pieces 7 and 8, one of which will of course be mag-

netized positively and the other negatively.

The numeral 9 indicates a spool of insulating material which is placed around the bottom of the central magnet-core 3 and on which the coil 5 is directly wound. A small passage 10 extends axially through the core 3 to form a well, in which mercury is placed, the bottom of the said well being closed by a plug 11.

Secured to and embedded within the heavy disk 12 of insulating material, which is secured in the upper end of the base or socket 1, is an involute or spirally-wound contact-piece 13, formed of carbon or other conductor of high resistance. The upper edge of the spiral contact 13 projects very slightly above the face of the disk 12, in which it is embedded, and, as will be noted by reference to Fig. 1, the face of the said disk 12 is slightly concaved or depressed.

The diaphragm is indicated by the numeral 14 and is shown as clamped at its peripheral edge against the edge of the disk 12 by means of a cap or cover 15, which has screw-threaded engagement with the base or socket 1, as shown at 16, and is provided at its central portion with a perforated hub 17, into which the small end of a speaking bell or horn 18 is screwed or otherwise secured. The said diaphragm 14 is constructed of mica or some other suitable non-conducting material, and on its under face it is provided with a thin conducting-strip or contact 19, that is spirally extended, or, more precisely stated, is extended spirally immediately over the contact-piece 13. This spirally-extended conducting-strip or contact 19 may be constructed in various ways; but it is advisably painted or stuck on the face of the diaphragm 14 by the use of what is known as "metallic ink" mixed with lampblack or other suitable conductor of high resistance, which will give the same the required body. At its center the diaphragm 14 is provided with a soft-iron armature 20, which is suitably secured thereto and is provided at its center with a depending needle-pointed contact-pin 21, which is preferably secured thereto for vertical adjustments by screw-threaded engagement therewith. The depending point of the contact-pin 21 normally stands with very slight engagement or contact with the upper portion of the column of mercury z , which is within the chamber 10 of

the magnet-core 3. The inner extremity of the spiral contacts or conducting-strips 13 and 19 normally have contact only at their outer extremities, so that the resistance through the main circuit is normally very high, and but very little current will normally flow. The spiral contacts or conducting-strips 13 and 19 and also the mercury z and needle 21 constitute what are usually designated as "micro-
10 phonic" contacts.

In the illustration given the circuit connections are as follows: At each station and for each instrument there is provided a local-circuit wire 22, which involves the coil 5, heretofore noted, as a section thereof and has interposed therein a battery 23. One terminal of the circuit-wire 22 extends through the plug 11 into the column of mercury z , and the other terminal thereof is, as shown, connected to a binding-post 24. Under some circumstances the circuit-wire 22 would be grounded, as indicated by the dotted lines marked 25 on Fig. 5, although this wire may and preferably is in most cases dispensed with. One terminal 25 of the coil 4 is connected to the inner terminal or end of the embedded spiral contact 13, while the other terminal of the said coil is extended at 28 and, as shown, connected to a binding-post 29. The binding-posts 24 and 29 of the first and of the last instruments, respectively, of the system are grounded by wires 30 and 31, respectively. Where but two instruments are connected in the system, the binding-post 29 of the first instrument is connected to the binding-post 24 of the last instrument by a line-wire 32. If more than two instruments are connected in the system, as would usually be the case, the others would be interposed in the line-circuit 32—that is, 40 their binding-posts 24 and 29 would be connected to the sections of the said line-wire 32.

In the illustration given in Fig. 5 a grounded circuit is employed; but it will of course be understood that a complete metallic circuit 45 might be employed, if desired.

Operation: The connection to the batteries is such that the current will flow or may be assumed to flow as indicated by the arrows marked on Fig. 5. Normally but very little current will flow through the circuit in view of the high resistance at the contacts 13 and 19 and points of the contact-pins 21, and hence the magnets 2 3 will have but very little action or influence upon the armatures 20 of the diaphragms 14. However, when a person 55 talks into one of the speaking bells or horns 18 the vibrations produced in the air within the cap 15 will vibrate the said diaphragm corresponding to the intensity and pitch of the voice, and these vibrations of the diaphragm will bring the point of contact between the spiral contact-pieces or conductors 13 and 19 nearer to or farther from the center of said diaphragm, thereby varying the resistance of the circuit and correspondingly 65 varying in an inverse ratio the flow of the current. The vibrations of the diaphragm

also vary the contact between the point of the contact-pin 21 and the mercury, so that the resistance of the circuit at this point is also varied. The variations of the intensity 70 of the current in the main circuit acting on the magnetic cores 2 3 of the next adjacent instrument or other instruments of the system will vary their magnetic intensity, so as to cause vibrations of the diaphragm of that instrument or those instruments corresponding to the vibrations of the diaphragm of the instrument which is acting as a transmitter or which is being talked into and directly 80 acted upon by the voice. Thus the instrument being talked into, as already indicated, will act as a transmitter, while the other instrument or instruments of the system or series will act as receivers. The current flowing 85 from a distant instrument will pass through and energize the coil 5, which is wound around the core 3 and will energize the magnet formed by the cores 2 3. The current after flowing through the coil 5 is strengthened or reinvigorated by the local battery 23, so that in passing through the coil 4 it will very greatly increase the strength of the magnet and intensify its magnetic action on the armature 20 of the diaphragm of that instrument. In this manner, and, further, in virtue of the marked 95 increases and decreases in the resistance afforded by the varying or differential contact between the contact-pieces 13 and 19, the vibrations of the diaphragm of the receiving instrument are increased to such an extent that the audible sounds produced may be heard at considerable distances. Hence the operator or person receiving the message does not necessarily stand in the immediate vicinity 105 of the instrument.

As the batteries are connected up in relays, each instrument is caused to act as a repeater to send forth to the next adjacent instrument reenergized electrical impulses. 110

What we claim, and desire to secure by Letters Patent of the United States, is as follows:

1. A telephone comprising in combination, a spiral contact, a diaphragm located adjacent to said spiral contact and having formed 115 on its face a spiral contact of high resistance, positioned for a differential contact with said above-noted spiral contact, under the vibrations of said diaphragm, and suitable circuit connections to and from said spiral contacts, 120 substantially as described.

2. In a transmitter, the combination with a spiral contact depressed at its central portion, of a diaphragm of non-conducting material positioned adjacent to said spiral contact and provided on its face with a spiral contact of high resistance, positioned for differential engagement with said above-noted spiral contact under vibrations of said diaphragm, and suitable circuit connections to 125 and from said spiral contacts, said parts operating substantially as described.

3. In a telephone system, the combination with the main circuit, of a plurality of instru-

ments connected in said main circuit, each instrument involving a microphonic contact, an electromagnet both poles of which are arranged for action on said contact, and a re-
5 inforcing-battery located in the main circuit between the poles of said electromagnet, substantially as described.

4. In an instrument of the character described, the combination with the main circuit and a microphonic contact therein involving a movable armature, of an electromagnet in said circuit having concentric pole-pieces both arranged for action upon said armature, substantially as described.

15 5. In an instrument of the character described, the combination with the main circuit

and a microphonic contact therein involving a vibrating armature, of an electromagnet having concentric cores and pole-pieces, both of said pole-pieces being positioned for action on said armature, and the
20 said main-circuit wire being wound around both of said cores, and a battery in the main circuit between the coils on the said core-pieces, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

MICHAEL BECK.
EMIL FERRANT.

Witnesses:

MABEL M. MCGRORY,
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